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10 June 1958

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K-114

Colonel P. E. Orr
Ballistic Missile Division
Air Research and Development Command
P.O. Box 262
Inglewood, California

Dear Pete:

As you know, we are interested in all aspects of reconnaissance, with a long standing interest and activity in reconnaissance satellites.

Our interest in and activity on new ideas runs parallel to a continuing interest and activity on current programs. It is in that spirit that we are submitting the following suggestion for your consideration in connection with WS-117L.

Subsystem 2 is now such a complex of interlocking pieces that making any substantial changes is impossible. Minor changes may be feasible, and, if desirable, fairly easily brought about. As we have observed the growth of this subsystem from camera, through processor, readout, and transmission, one component in particular has caught our attention. This is the camera, the first link in the chain. This letter is about the camera.

It was more than two years ago, at the Dayton briefing by the several Pied Piper contractors, that we first heard about the 6-in. focal length 70 mm strip camera proposed for use in WS-117L. At that same time, in a meeting with project personnel, ARE, Lockheed, and Eastman, we suggested that high-altitude flight tests be conducted, using stabilized mounts and the S-10 camera--which is a 70 mm strip camera. Tests with this system would prove very illuminating and useful in studying the problems in acquiring and using small scale strip photography.

That this was not done is regrettable, but, possibly, it can still be done. In any event, let's look briefly at the camera in 117L.

The 6-in. f/3.5 lens in the pioneer vehicle exposes film at a nominal 0.1 in./sec film velocity. The slit width is about 0.002 in. and, as I recall, is about 0.007 in. from the focal plane. It is, therefore, the equivalent of a 30 per cent efficient focal plane shutter with an actual open time of 1/25 sec, and an effective exposure time of 1/50 sec.

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This corresponds to a 1 sec exposure in a vehicle moving at about Mach 2.0.

Now, unless the very first models of the satellite are so stable, and the camera operation so essentially perfect that 'sharp' photographs are produced, it will likely be difficult to study and foster out the subsequent operations of processing, readout, and transmission.

We are suggesting replacement of the Eastman camera with a camera like the P-2. The reasons for considering this are:

1. Backup for the Eastman camera
2. Usefulness in test programs.

Before describing its use, let's describe the general nature of modern 70 mm cameras.

Perhaps it is of relevance only to the writer (certainly it is, at best, of historical interest only) that in 1945 the writer did the experimental work and then wrote the specifications for the 70 mm strike attack camera. This specification has remained essentially unchanged today, and yielded the P-1, P-2, and similar cameras.

This camera is a 70 mm square frame type, rapid cycling (up to 5 or 6 frames/sec), with shutter speeds that range from 1/500 sec to 1/2000 sec. Variations of this general camera type feature shutter speeds up to 1/4000 sec. Excellent lenses are available for the P-2. For example, the commercially available 6-in. f/2.8 Schneider Xenotar, has produced close to 100 lines/mm on E. K. Emulsion No. 1213 in actual aerial tests--and this without special mounting, IMC, or any frills.

To see that series we think would be interesting, let us label the camera chain components as follows:

A. The Camera
B. The Processor
C. The Readout
D. The Video Link

To see whether and how C and D work, we would start with a roll of already processed film, whose quality is known, and a dupe of which is kept on the ground. Thus, any questions about the quality entering C and D are eliminated.

To check the processor B, we could start with a roll of film exposed in an aircraft. A twin of this roll, taken in an identical camera at the same time (with cameras one and two rigidly connected) would be ground processed and examined. The first roll would be space-processed, etc.

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To check the camera of whatever type (and the stabilization system), it might be possible to run some film through the camera, stop exposing film in the camera, and run a pre-exposed film (with a control dupe on the ground) on a butt-splice (in series with the space-exposed film) through B, C, and D.

Other combinations of the techniques listed here may occur to your staff. These are illustrative only, and the list is obviously incomplete.

Another interesting possibility is opened up here. If for any one of a number of off-white purposes, it is desirable to have the video link information intercepted, it should be possible to arrange interception of either a very poor signal (lower quality than average) or a very high quality signal (say, higher quality than average).

Clearly, the use of a high shutter speed frame camera in 117L may be thought of for use in connection with the kind of test program roughly outlined above, or as a backup to the Eastman camera, or, simply as a substitute for the Eastman camera. Of course, we realize that replacement of the camera is not as easily done as said.

High speed focal plane shutters normally generate vibration and transient shocks. Serious attention would have to be given to this problem.

It would seem desirable to be able to check satellite attitude from the ground in the event of telemetry failure.

Another idea not directly connected with the airborne machinery is that of using high quality ground-mounted telescopic recorders for visual inspection of the satellite. The application of this idea to inspection of our satellites comes as a natural extension of techniques for inspection of other people's satellites. It should suffice for present purposes to note that this seems feasible.

Because the essential points of this idea have been previously discussed with various members of your project office, and some people from RADC, it may be that you are already aware of the nature of this suggestion. Further, we are not completely familiar with all the details of test programs, so this letter may make some points already documented. If so, fine.

With best wishes for success of the important projects now underway, I remain

Sincerely yours

Aaron Kats
Electronics Department

AHK:mlg

cc: Major General Bernard Schriever
Ballistic Missile Division

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